Utah State Building Board

Jon M. Huntsman, Jr.
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MEMORANDUM

To: Utah State Building Board
From: David G. Buxton
Date: April 8, 2009
Subject: **Approval for State Facility Energy Efficiency Fund Loan Application for Department of Human Services, Utah State Developmental Center Facility**

As per the Administrative rules for the Energy Efficiency Revolving Loan fund each application for funding needs Building Board approval prior to moving forward with energy projects. Attached is an application pending approval for the Department of Human Services, Utah State Developmental Center facility.

This application has been reviewed and approved by the SBEEP Manager and is submitted for your approval.

DGB:JW:sle

Attachment

State of Utah
State Facility Energy Efficiency Fund Loan Application

A. State Agency:

Department of Human Services
120 North 200 West, Suite 419
Salt Lake City, UT 84103

B. Building name & location:

Utah State Developmental Center
895 North 900 East
American Fork, UT 84003

This scope of this project includes work in 4 separate buildings: New Administration Building, Old Administration Building, Heather Lodge & Rose Building

C. Building description (use, seasonal variations, square footage):
See attached excerpt from Energy Audit Report for building descriptions

D. Existing building systems and energy usage:
See attached excerpt from Energy Audit Report for existing building systems (Tables B-1 through B-4)

E. Project Description:

Eligible Measure / Materials to be installed	Estimated Cost of Measure	Projected Annual Energy Savings	Projected Annual Cost Savings
Install new Building Automation System (BAS) and reschedule in New Admin, Old Admin and Heather Lodge	$121,500	150,000 kwh (elec) 1,020 DTH (gas)	$5,100 (elec) $7,500 (gas)
Install occupancy sensors and replace lighting with premium efficiency lighting in all 4 buildings	$24,000	44,500 kwh + 9.5 kw/month (demand)	$3,000
Add programmable thermostats in Rose Building	$6,500	4,000 kwh (elec) 11 DTH (gas)	$140 (elec) $80 (gas)
Engineering	$18,000		
TOTAL	**$170,000**		**$15,820**

F. Rebates and Incentives:

Provider and type of rebate or incentive	Estimated Amount of incentive
Questar Gas	$7,500
Rocky Mountain Power self-directed credit	$136,000
TOTAL	$143,500

G. Payback
$170,000 (total cost) - $136,000 (incentives) = $34,000 (post-incentive cost)
$34,000 (post-incentive cost) ÷ $15,820/year (energy savings) = **2.2 years**

H. Description of energy costs savings measurement and verification:
Measurement and verification to be done by a third-party engineer under the direction of Rocky Mountain Power.

I. Commissioning procedures:
N/A

J. Other benefits to the environment, community, agency, or State of Utah
The light quality will be better for the users of the facility, and the reduced power consumption will reduce CO_2 emissions.

K. Total eligible costs to be financed by this loan:

Estimated costs:	$170,000
Other funds to be used on project:	$0
Total proposed loan amount:	**$170,000**

L. Attachments
Excerpt from Energy Audit Report for Utah State Developmental Center, Nexant, February 9, 2009

A.1 INTRODUCTION AND BACKGROUND

The Utah State Developmental Center is a multi-building campus located in American Fork, UT. The facility offers medical treatment services to people with disabilities.

The goal of this energy audit is to identify energy savings opportunities and recommend energy conservation measures (ECM) at the following four (4) buildings located in the campus.

1. Old Administration Building
2. New Administration Building
3. Heather Lodge
4. Rose Warehouse

A.1.1 Summary of Findings and Recommendations

The purpose of this energy audit report is to demonstrate the opportunities available to Utah State Developmental Center to reduce electric and natural gas consumption through the implementation of various building envelope, lighting and mechanical ECMs. A summary of the baseline facility and the recommended ECMs is included in the following sections. Details pertaining to analysis methodology and measure implementation will follow in the later sections.

Table A-1 presents the ECMs recommended as a part of this report:

Table A-1. Recommended Energy Conservation Measures

ECM:	Old Administration Building	New Administration Building	Heather Lodge	Rose Warehouse
Install new BAS and rescheduling	•	•	•	
Install occupancy sensors and premium efficiency lighting	•	•	•	
Install programmable thermostats to control cabinet unit heaters and ceiling-hung unit heaters		•	•	•

Table A-2 to Table A-4 summarizes the energy savings, incremental costs, incentives, and economics of each ECM.

Table A-2. Energy Costs Used in the Analysis

Rocky Mountain Power	
Rate Schedule	8-Primary
Customer Efficiency Service Charge (%)	2.12%
Energy Charge ($/kWh)	0.034440
Demand Charge ($/kW/month)	13.00731

Questar Gas (From Facility Utility Bills)	
Energy Charge ($/Dth):	$ 7.37

Table A-3. Estimated Energy Savings Summary[1]

ECM Number	Measure Name	Annual Energy Savings (kWh/year)	Peak Demand Savings (kW/month)	Annual Natural Gas Savings (DTH/year)	Eligible Expenses ($)	Annual Electrical Cost Savings ($)	Annual Natural Gas Cost Savings ($)	Combined Energy Cost Savings ($)
1	Old Admin Building - Install new BAS and Rescheduling	64,891	-	519.2	$ 47,974.40	$ 2,234.84	$ 3,824.68	$ 6,059.52
2	Old Admin Building - Occ Sensors + Replace existing lighting with premium efficiency lighting	24,549	5.10	-	$ 10,688.00	$ 1,641.51	$ -	$ 1,641.51
3	New Admin Building - Install new BAS and Rescheduling	20,422	-	221.1	$ 48,266.40	$ 703.35	$ 1,628.86	$ 2,332.21
4	New Admin Building - Occ Sensors + Replace existing lighting with premium efficiency lighting	8,447	2.00	-	$ 3,816.00	$ 603.09	$ -	$ 603.09
5	Heather Lodge - Install new BAS and Rescheduling	64,800	-	279.9	$ 24,370.40	$ 2,231.70	$ 2,061.80	$ 4,293.50
6	Heather Lodge - Occ Sensors + Replace existing lighting with premium efficiency lighting	8,245	1.60	-	$ 4,281.00	$ 533.70	$ -	$ 533.70
7	Rose Building - Occ Sensors + Replace existing lighting with premium efficiency lighting	3,355	0.80	-	$ 4,300.00	$ 240.42	$ -	$ 240.42
8	Rose Building - Add Programmable Thermostats	4,151	-	11.50	$ 6,315.00	$ 142.96	$ 84.72	$ 227.68
	Total	198,860	9.50	1,031.61	$ 150,011.20	$ 8,331.57	$ 7,600.07	$ 15,931.64

[1] The costs for ECM-1 and 5 will be significantly lower if unitary controls are installed in lieu of integrating the new BAS to the web-based interface. This however, will limit the operator's ability to monitor/control the system remotely.

Table A-4. Estimated Incentives and Simple Payback Summary

ECM Number	Measure Name	RMP Pre-Incentive Simple Payback (years)	Questar Gas Pre-Incentive Simple Payback (years)	Combined Pre-Incentive Simple Payback (years)	Incentive ($)	Combined Post-Incentive Simple Payback (years)
1	Old Admin Building - Install new BAS and Rescheduling	21.47	12.54	7.92	$ 5,191.27	7.06
2	Old Admin Building - Occ Sensors + Replace existing lighting with premium efficiency lighting	6.51	-	6.51	$ 4,540.00	3.75
3	New Admin Building - Install new BAS and Rescheduling	68.62	29.63	20.70	$ 1,633.79	20.00
4	New Admin Building - Occ Sensors + Replace existing lighting with premium efficiency lighting	6.33	-	6.33	$ 1,472.00	3.89
5	Heather Lodge - Install new BAS and Rescheduling	10.92	11.82	5.68	$ 5,183.97	4.47
6	Heather Lodge - Occ Sensors + Replace existing lighting with premium efficiency lighting	8.02	-	8.02	$ 1,632.00	4.96
7	Rose Building - Occ Sensors + Replace existing lighting with premium efficiency lighting	17.89	-	17.89	$ 793.00	14.59
8	Rose Building - Add Programmable Thermostats	44.17	74.54	27.74	$ 1,000.00	23.34
	Total	**18.01**	**19.74**	**9.42**	**$ 21,446.04**	**8.07**

B.1 BASELINE MODELING

Analysis Methodology:

The buildings studied as a part of the scope of this audit were not individually metered for energy consumption. Information used in the analysis was derived mostly from site walkthroughs and staff interviews. Due to the age of the building and its equipment, some of the nameplate information was missing. This had to be estimated based on data from industry standard assumptions which were in turn derived from Commercial Building Energy Consumption Survey (CBECS), United Stated Green Building Council (USGBC) and past experience.

Since the analysis was performed during the winter of 2009, cooling equipment energy use could not be obtained. In order to model the baseline to the maximum possible accuracy, data from eQuest models were combined with TMY2 based bin-data. With the available data, an eQuest model was developed for the Old Administration Building. Due to similar nature of construction of the other office buildings in the scope of this audit, energy use index derived from the eQuest model for the Old Administration Building were applied to the other buildings to determine their individual energy use.

Based on staff interviews, it is understood that water use in the campus was not metered. As a result, water consumption savings have not been quantified.

B.1.1 Old Administration Building

Constructed in 1966, this 18,394 sq-ft one story building with basement houses part of the facility's administrative services wing. The building can be classified as 95% offices, open areas, storage rooms, restrooms and mechanicals rooms, and 5% computer rooms. Approximately 25 people occupy the building from 7am to 6pm, Monday to Thursday (normal business hours). Every occupant in the building has at least one personal computer. Majority of them have flat screen LCD monitors. The building is closed on Fridays, Saturdays and Sundays. Air circulation in the building is maintained through under floor constant volume ducts, registers and grills.

B.1.1.1 Equipment

Table B-1. Old Administration Building Equipment List

Equipment	Location	Area Served	Controls
Single Zone AHU-1	Basement Mechanical Room-2	Corridors and Open Spaces	• Stand-alone pneumatic controls • Steam Heating Coils • Hydronic Glycol Cooling Coils • Economizer Dampers manually locked at approximately 0% OA • ~68°F summer DAT setpoint (based on staff interviews)

Equipment	Location	Area Served	Controls
			• ~78°F winter DAT setpoint • One (1) booster pump equipped with standard efficiency ¾ HP motor on chilled water return coils • One (1) supply fan equipped with 2 HP standard efficiency motor • 24/7 Operating Schedule
Multi-Zone AHU-2	Basement Mechanical Room-1	Basement Offices	• Stand-alone pneumatic controls • Steam Heating Coils • Hydronic Glycol Cooling Coils • Economizer Dampers manually locked at approximately11% outside air (OA) • ~68°F cold deck discharge air temperature (DAT) setpoint (based on staff interviews) • ~78°F hot deck DAT setpoint • One (1) booster pump equipped with standard efficiency ¾ HP motor on chilled water return coils • One (1) supply fan equipped with 2 HP standard efficiency motor • 24/7 Operating Schedule
Multi-Zone AHU-3	Basement Mechanical Room-2	First Floor Offices	• Stand-alone pneumatic controls • Steam Heating Coils • Hydronic Glycol Cooling Coils • Economizer Dampers manually locked at approximately11% OA • ~68°F cold deck discharge air temperature DAT setpoint (based on staff interviews) • ~72°F hot deck DAT setpoint • One (1) booster pump equipped with standard efficiency 1 HP motor on chilled water return coils • One (1) supply fan equipped with 7 HP standard efficiency motor • 24/7 Operating Schedule
Chiller	Outside the Basement Mechanical Room-2	Entire Building	• 42-ton air-cooled Carrier™ screw chiller • Manual on/off schedule • Energized approximately between May 1 and November 1 every year depending on outside air conditions • No existing HVAC scheduled maintenance service contract • Approximately 15-20 years old
Computer Room air Conditioning	Outside the Basement Mechanical Room-2	Basement Computer Server Room	• ~ 5-ton Split System • Operates to maintain 68°F in the server room throughout the year

Equipment	Location	Area Served	Controls
(CRAC) Unit			
Heating	Central Plant (Separate Boiler Building in campus)	All Buildings in the Campus	• Steam produced by Natural Gas fired Boilers • Boilers were built in 1966 (as per nameplate)
Windows	Building Envelope	Building Envelope	• Single Pane Clear Tint • Aluminum Frame
Lighting	Building Core	Building Core	• 32-watt T8 lamps and fixtures • Some task lighting with incandescent lamps in individual offices • Compact fluorescent lamps in mechanical rooms

B.1.2 New Administration Building

Constructed in 1976, this 7,742 sq-ft one story building houses another part of the facility's administrative services wing. The building can be classified as 96% offices, open areas, storage rooms, restrooms and mechanicals rooms, and 4% telephone switchboard room. Approximately 12 people occupy the facility from 7am to 6pm, Monday to Thursday (normal business hours). Every occupant in the building has at least one personal computer. Majority of them have flat screen LCD monitors. The building is closed on Fridays, Saturdays and Sundays.

B.1.2.1 Equipment

Table B-2. New Administration Building Equipment List

Equipment	Location	Area Served	Controls
Single-Zone AHU-1	Basement (Mezzanine) Mechanical Room	Common Areas	• Stand-alone pneumatic controls • Hydronic Heating Coils • Electric Preheating Coils (set to control air at 38°F) • Hydronic Cooling Coils • Economizer Dampers manually locked at approximately 27% OA (based on mixed air temperature (MAT), return air temperature (RAT) and outside air temperature (OAT) recorded on the day of the walkthrough) • ~68°F summer DAT setpoint (based on staff interviews) • ~95°F winter DAT setpoint • One (1) supply fan equipped with ¾ HP standard efficiency motor • 24/7 Operating Schedule
Single-Zone AHU-2	Basement (Mezzanine) Mechanical Room	Common Areas	• Stand-alone pneumatic controls • Hydronic Heating Coils • Electric Preheating Coils (set to control air at 38°F) • Hydronic Cooling Coils

Equipment	Location	Area Served	Controls
			• Economizer Dampers manually locked at approximately 27% OA (based on MAT, RAT and OAT) recorded on the day of the walkthrough) • ~68°F summer DAT setpoint (based on staff interviews) • ~95°F winter DAT setpoint • One (1) supply fan equipped with 2 HP standard efficiency motor • 24/7 Operating Schedule
Chiller	Basement (Mezzanine) Mechanical Room	Entire Building	• 30-ton air-cooled Trane™ scroll chiller • Manual on/off schedule • Energized approximately between May 1 and November 1 every year depending on outside air conditions • No existing HVAC scheduled maintenance service contract • Approximately 38 years old
Condensing Unit	Building Roof	Chiller heat rejection	• Manually controlled
Cabinet Unit Heaters	Offices and Open Areas	Localized Heating and Cooling	• 4-pipe heating/cooling system • Hydronic heating/cooling coils • Controlled via pneumatic wall-mount space thermostats set at different space temperature setpoints • 24/7 Operating Schedule
Heating	Central Plant (Separate Boiler Building in campus)	All Buildings in the Campus	• Steam produced by Natural Gas fired Boilers • Steam to hot water (HW) heat exchanger facilitate hot water for space heating • Boilers were built in 1966 (as per nameplate)
Windows	Building Envelope	Building Envelope	• Single Pane Clear Tint • Aluminum Frame
Lighting	Building Core	Building Core	• 32-watt T8 lamps and fixtures • Some task lighting with incandescent lamps in individual offices • Compact fluorescent lamps in mechanical rooms

B.1.3 Heather Lodge

Constructed in 1967, this 12,560 sq-ft one story building with basement houses the facility's records processing wing. The building can be classified as 75% offices, open areas, storage rooms, restrooms and mechanicals rooms, and 25% records storage space. Approximately 11 people occupy the facility from 7am to 6pm, Monday to Thursday (normal business hours). Every occupant in the building has at least one personal computer. Majority of them have flat screen LCD monitors. The building is closed on Fridays, Saturdays and Sundays. Space temperature is controlled via wall-mounted pneumatic thermostats which appear to control the

respective zone's mixing air dampers. Some zone thermostats are located near printers and copy machines. Other zone thermostats are located in individual office spaces. This results in inadequate space temperature in several spaces throughout the facility.

B.1.3.1 Equipment

Table B-3. Heather Lodge Equipment List

Equipment	Location	Area Served	Controls
Multi-Zone AHU-1	Basement Mechanical Room	Common Areas	• Stand-alone pneumatic controls • Steam Heating Coils • DX Cooling Coils • Economizer Dampers manually locked at approximately 0% OA (based on MAT, RAT and OAT recorded on the day of the walkthrough) • ~68°F cold deck DAT setpoint (based on staff interviews) • ~108°F hot deck DAT setpoint • One (1) supply fan equipped with 10 HP (estimated) standard efficiency motor[1] • 24/7 Operating Schedule
Condensing Unit	Outside Basement Mechanical Room	Multi-Zone AHU-1	• 30-ton air-cooled Trane™ DX condensing unit with refrigerant coils piped directly to the AHU's airstream • Manual on/off schedule • Energized approximately between May 1 and November 1 every year depending on outside air conditions • No existing HVAC scheduled maintenance service contract • Approximately 20 years old
Heating	Central Plant (Separate Boiler Building in campus)	All Buildings in the Campus	• Steam produced by Natural Gas fired Boilers • Boilers were built in 1966 (as per nameplate)
Windows	Building Envelope	Building Envelope	• Single Pane Clear Tint • Aluminum Frame
Lighting	Building Core	Building Core	• 32-watt T8 lamps and fixtures • Some task lighting with incandescent lamps in individual offices

B.1.4 Rose Warehouse

Constructed in 1967, this 12,560 sq-ft one story building with basement houses the facility's supplies processing wing. 40% of the building comprises administration offices, open areas and

[1] Motor nameplate was missing from the supply fan motor. Motor HP estimated based on building square-footage.

restrooms, and 60% warehouse space. Approximately 5 people occupy the facility from 7am to 6pm, Monday to Thursday (normal business hours). Every occupant in the building has at least one personal computer. Majority of them have flat screen LCD monitors. The building is closed on Fridays, Saturdays and Sundays. Space heating is controlled via one wall-mounted pneumatic thermostat[1] which controls the building's central steam valve.

B.1.4.1 Equipment

Table B-4. Rose Warehouse Building Equipment List

Equipment	Location	Area Served	Controls
Window mounted air-conditioning (AC) units	Individual Office Areas	Individual Office Areas	• Built-in standard stand-alone controls • Refrigerant cooling coils • 24/7 operating schedule during summer (estimated based on staff interviews)
Window mounted evaporative cooling AC units	Individual Office Areas	Individual Office Areas	• 24/7 operating schedule during summer (estimated based on staff interviews)
Cabinet Unit Heaters	Individual Office Areas	Individual Office Areas	• Steam heating coils controlled via central space thermostat located in the corridor • 24/7 operating schedule during winter
Unit Heaters	Individual Office Areas and Warehouse	Individual Office Areas and Warehouse	• On/Off operation of warehouse units controlled via a line voltage thermostat • Steam heating coils • 24/7 operating schedule during winter
Heating	Central Plant (Separate Boiler Building in campus)	All Buildings in the Campus	• Steam produced by Natural Gas fired Boilers • Boilers were built in 1966 (as per nameplate)
Windows	Building Envelope	Building Envelope	• Single Pane Clear Tint • Aluminum Frame
Lighting	Building Core	Building Core	• 32-watt T8 lamps and fixtures • Some task lighting with incandescent lamps in individual offices

[1] Manually set to control space temperature at 85°F, the sensor is mounted in the corridor at approximately 10 ft above finished floor

The baseline eQuest model revealed the following information about the baseline energy use.

Table B-5. eQuest estimated Baseline Energy Use

Building Name	Baseline Annual Electric Energy Use (kWh/year)	Baseline Annual Natural Gas Energy Use (Decatherms (DTH) /year)
Old Administration Building	206,750	1,383.7
New Administration Building[1]	88,051	589.3
Heather Lodge[1]	111,454	745.9
Rose Warehouse[1]	115,382	772.2

[1] *Electrical and Natural Gas consumption estimated based on the assumption that the EUI for New Administration Building, Heather Lodge and Rose Warehouse are the same as that for the Old Administration Building.*

B.2 RECOMMENDATIONS

The following ECMs are recommended as a part of this report:

ECM: Implement BAS Improvements and Operation Schedules:
Buildings Recommended: Old Admin Building (ECM-1), New Admin Building (ECM-3), Heather Lodge (ECM-5), Rose Warehouse (ECM-8)

The existing HVAC systems at the air-handling equipment are pneumatically controlled. Due to age and due to wear and tear the existing control system is not fully functional. This measure recommends the following:

- **Install a new DDC based BAS**:
  Replace the existing pneumatic control system with DDC based BAS.
- **Integrate with existing web-based user interface**: In order to monitor and adjust the BAS' system settings from a remote location, the new BAS must be integrated with the facility's existing web-based TAC controls system.
- **Schedule the HVAC systems to operate based on the building's occupancy schedule**: The HVAC systems (i.e., the AHU, chillers and pumps) must be scheduled to operate from 5am to 6pm Monday to Thursday. The HVAC systems must remain OFF on Fridays, Saturdays, Sundays and approved holidays[1].

As a part of the new DDC installation, electronic space thermostats with override and setback functionality must be provided. The BAS must be programmed such that any authorized user

[1] During the unoccupied (OFF) periods, the HVAC systems must continue to operate based on a setback algorithm (i.e., high-limit and low-limit space temperature setpoints).